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(54) Prosthesis positioning devices

(57) Apparatus for use in accurately inserting an acetabular cup, comprising an acetabular jig device mountable at the acetabulum for guiding a cutting tool to form in the acetabulum a cut-away of a desired profile at desired orientation and position, said device including an acetabular locating member, and a femoral locating device mountable at the femur and including a femoral locating member for co-operating with said acetabular locating member to aid in locating said acetabular jig device correctly relative to said acetabulum.

Also described is apparatus for use in accurately inserting a stemmed prosthesis, comprising a version indicating device mountable upon a stemmed member for intramedullary introduction and including a support, an angular scale centered upon an axis, and an indicator turnable about said axis.

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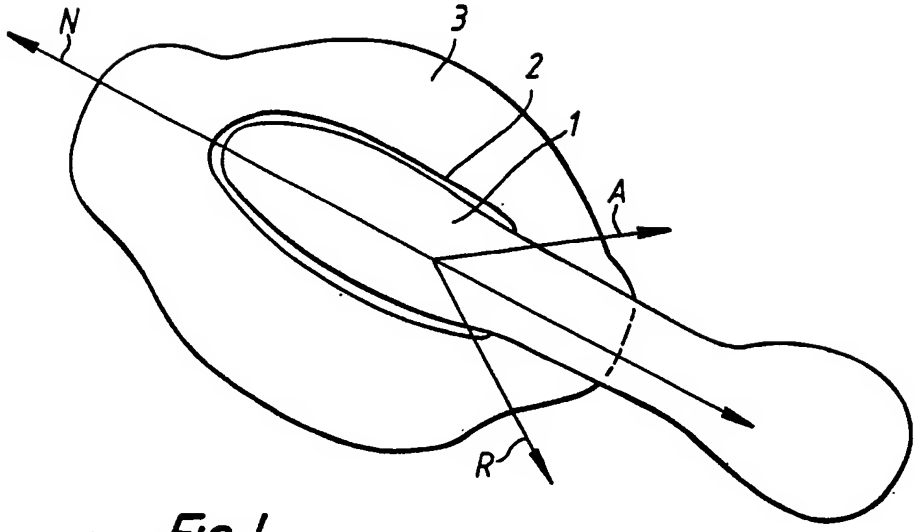


FIG. 1.

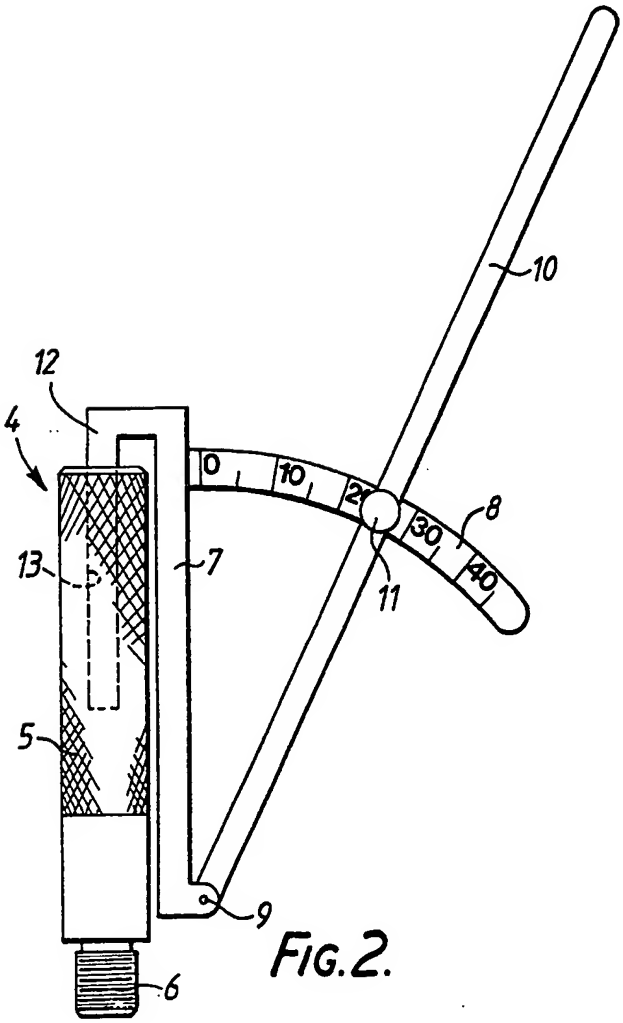


FIG. 2.

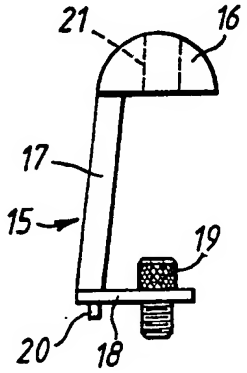


FIG. 3.

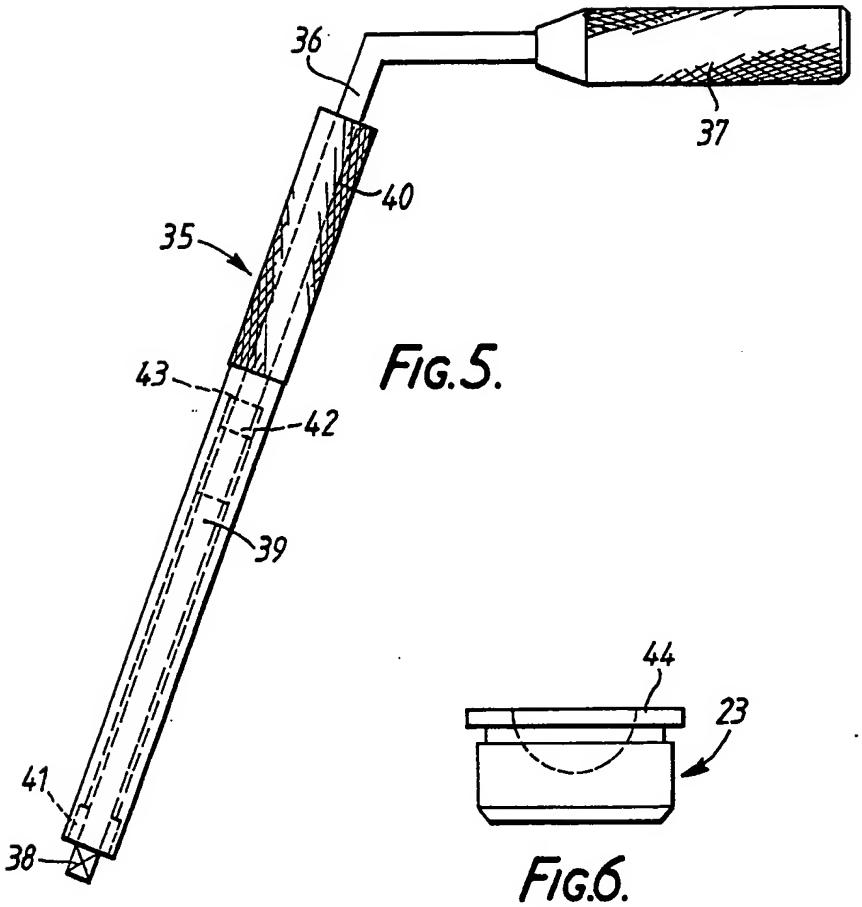


FIG.5.

FIG.6.

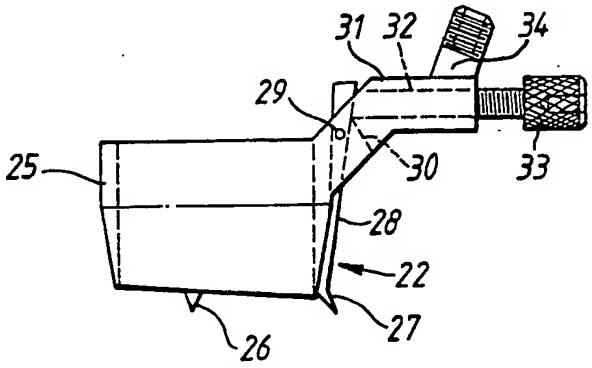


FIG.4.

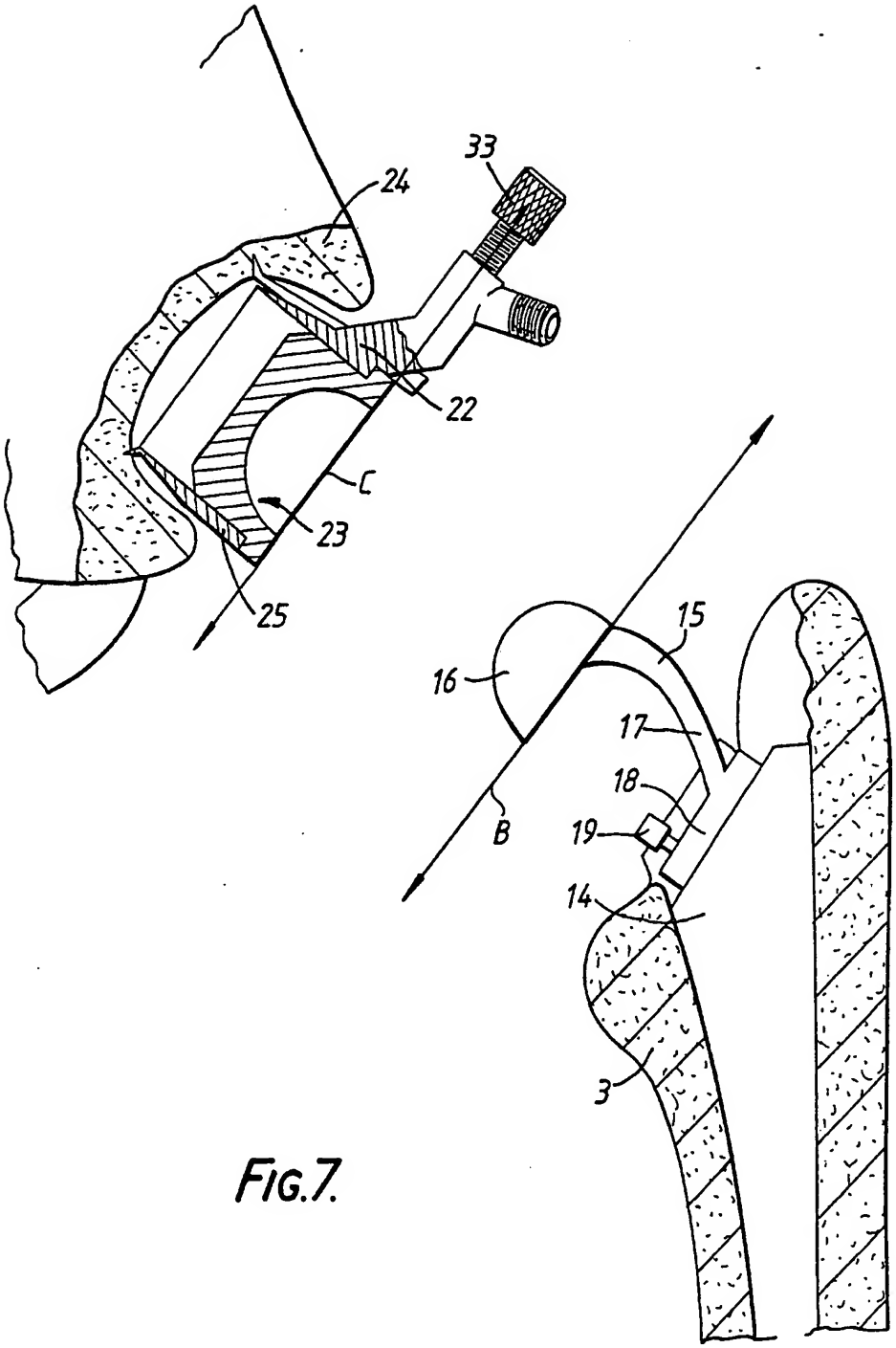
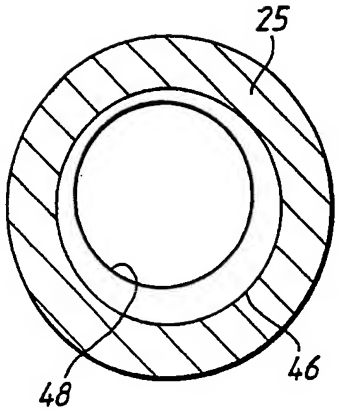


FIG.7.



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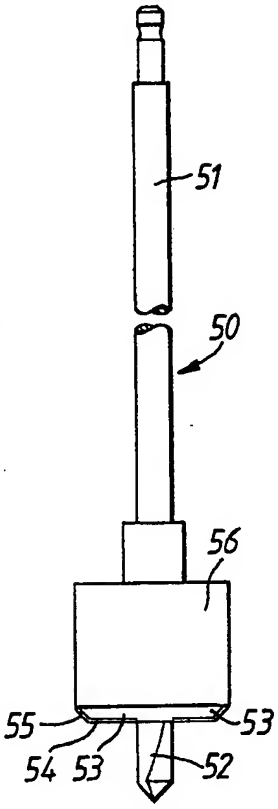
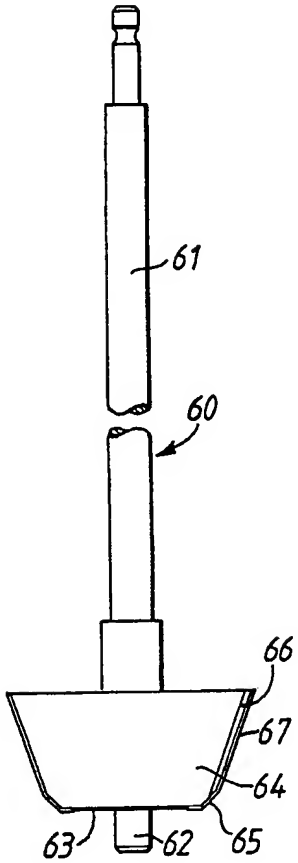


FIG.10.



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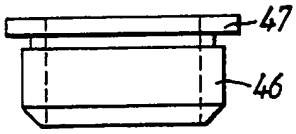
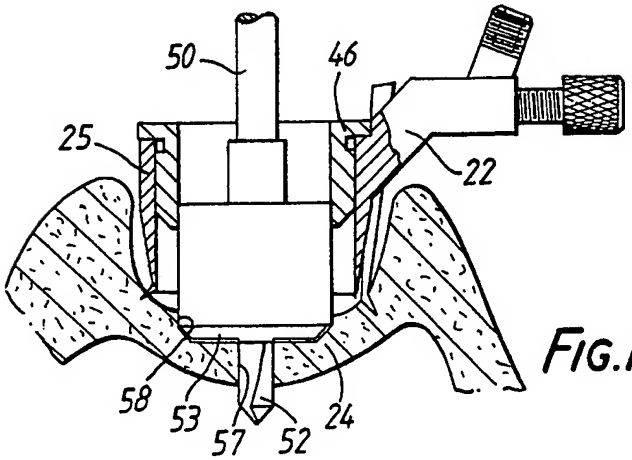


FIG.8.



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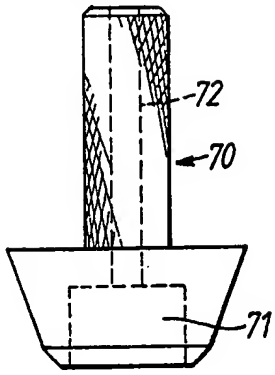

FIG.13.

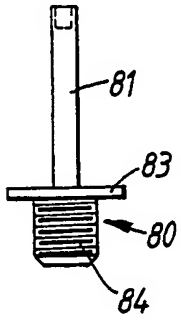

FIG.14.

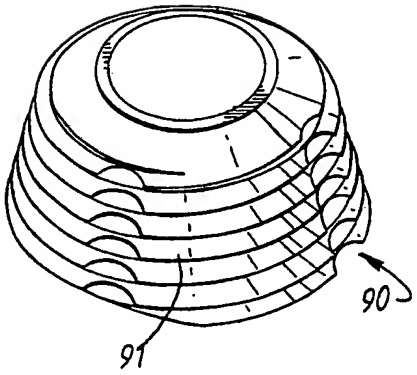

FIG.16.

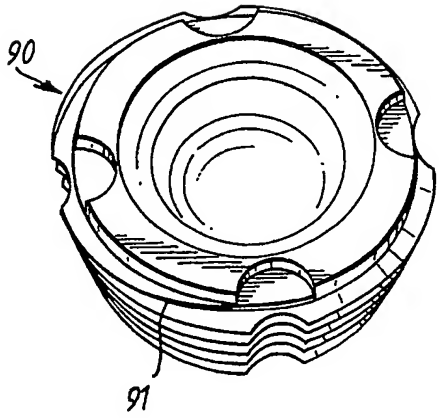

FIG.17.

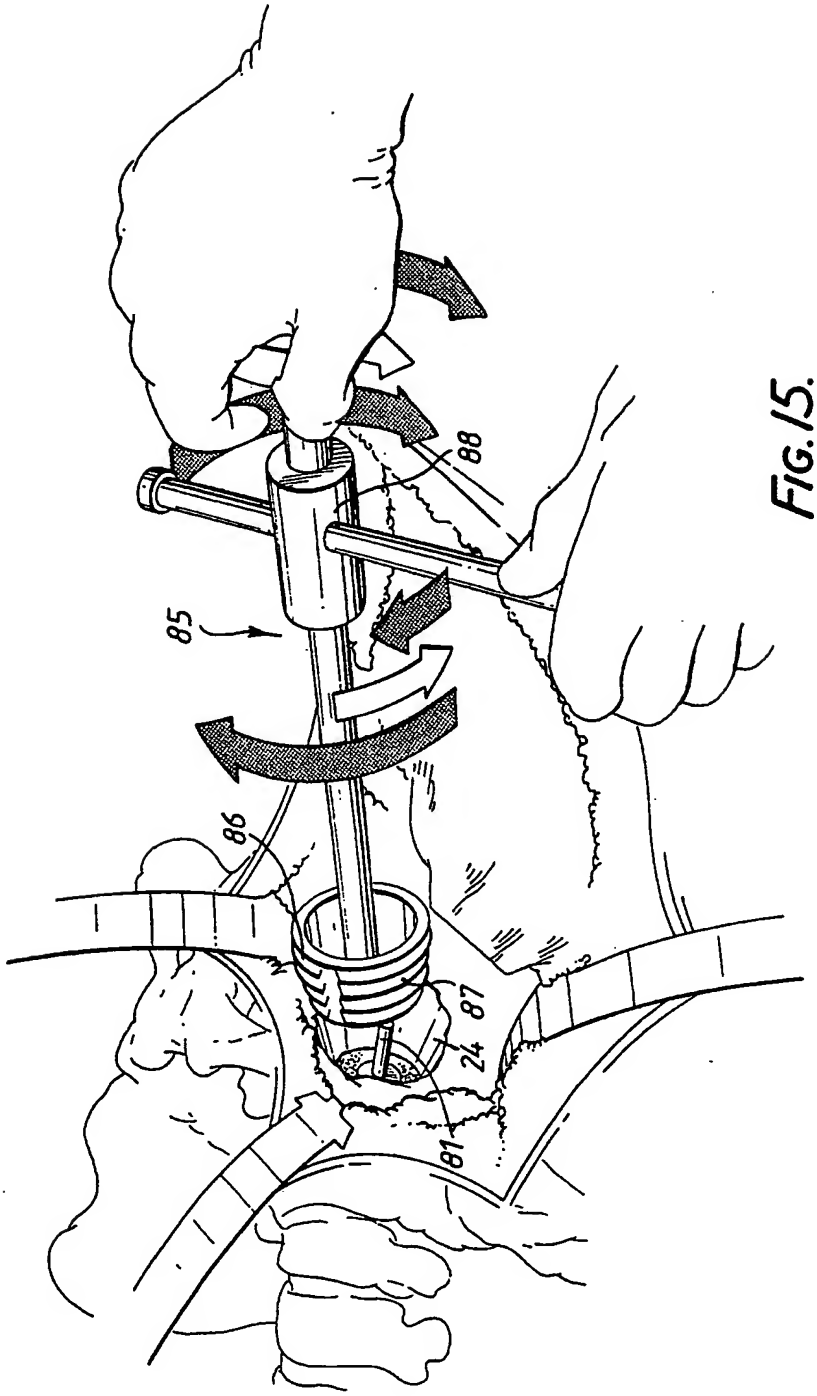

FIG. 15.

" APPARATUS FOR USE IN ACCURATELY INSERTING PROSTHESES".

According to one aspect of the present invention, there is provided apparatus for use in accurately inserting an acetabular cup, comprising an acetabular jig device mountable at the acetabulum for guiding a cutting tool to form in the acetabulum a cut-away of a desired profile at desired orientation and position.

According to another aspect of the present invention, there is provided apparatus for use in accurately inserting a stemmed prosthesis, comprising a version indicating device mountable upon a stemmed member for intramedullary introduction and including a support, an angular scale centered upon an axis, and an indicator turnable about said axis.

In order that the invention may be clearly understood and readily carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a diagrammatic plan view of a femur with a stemmed femoral hip prosthesis inserted therein,

Figure 2 shows a plan view of an anteversion indicating device forming part of apparatus for use in accurately inserting hip prostheses,

Figure 3 shows a side elevation of a trial head device for attaching to a femoral rasp and also included in the apparatus,

Figure 4 shows a side elevation of an alignment bush of an acetabular jig device forming part of the apparatus,

Figure 5 shows a side elevation of a handle of the jig device,

Figure 6 shows a side elevation of a trial acetabular cup forming part of the apparatus,

Figure 7 shows a sectional side elevation of the trial cup and the jig device mounted in the acetabulum

and the trial head device and the femoral rasp mounted in the femur,

Figure 8 shows a side elevation of an eccentric bush of the acetabular jig device,

Figure 9 is a sectional, diagrammatic plan view of the eccentric bush mounted in the bush of the jig device,

Figure 10 shows a fragmentary side elevation of an end-cutting reamer of the apparatus,

Figure 11 shows a sectional side elevation of the reamer of Figure 10 in use,

Figure 12 shows a side elevation of a side-cutting reamer of the apparatus,

Figure 13 is a side elevation of a tubular guide of the apparatus,

Figure 14 is a side elevation of a guide pin of the apparatus,

Figure 15 is a diagrammatic perspective view of an acetabular thread tapping device of the apparatus,

Figure 16 is a perspective view from above of a cementless acetabular cup prosthesis to be inserted by the surgeon, and

Figure 17 is an underneath perspective view of that cup prosthesis.

There is illustrated in the drawings a cementless, total hip joint replacement system. In this system, the surgeon commences by setting accurately the desired position of the femoral prosthesis and then uses the position of the femoral prosthesis head as a reference position for correct orientation and position of the acetabular prosthesis. In order to give a good range of stable hip movement, thus avoiding dislocation, it is important that the femoral prosthesis should be in version with respect to the neutral orientation of the femur relative to the acetabulum at an angle selected by the surgeon; in fact, it is generally accepted that

it is best in anteversion to the extent of an angle which varies with the circumstances, but is normally about 15° to 20°. Figure 1 illustrates a stemmed femoral prosthesis 1 inserted in the enlarged oval intramedullary cavity 2 of the femur 3, the prosthesis 1 lying substantially in the neutral plane N of the femoral neck. A plane R of 20° retroversion is illustrated, as also is a plane A of 20° anteversion. It is difficult for a surgeon using a femoral rasp to enlarge the cavity 2 to be certain that he is orientating the rasp at the desired angle of version. The device shown in Figure 2 makes achievement of this much easier for the surgeon. In using a known femoral rasp, the surgeon holds a handle which is substantially co-planar with the rasp and which screws into a threaded bore in the proximal end of the rasp. The device shown in Figure 2 includes a knurled cylindrical handle 5 to which is fixed co-axially a threaded stub 6 which screws into a bore formed in the rasp handle transversely to the longitudinal direction of the rasp handle, the axis of that bore being perpendicular to the plane of the rasp. The device 4 further includes a bracket 7 which is formed with an arcuate, angular scale 8, the centres of the arc and the scale being at a pivot 9 perpendicular to the axis of the handle 5. The bracket 7 turnably carries by way of the pivot 9 a pointer 10 which by means of a set screw 11 can be adjustably set at a desired angle on the scale 8. The bracket 7 is formed with an extension 12 which is slidably fitted in a bore 13 formed coaxially in the handle 5. The capability thereby provided of being able to turn the bracket 7 through 360° about the handle 5 enables the device 4 to be used selectively at the left and right hip joints and also enables the surgeon to select for anteversion and retroversion.

The surgeon can employ the device 4 as a sighting

instrument in which one of the handle 5 and the pointer 10 is aligned with a reference point in the lower limb to allow a selected angle of version to be achieved. Then, with the pointer 10 fixed relative to the scale and the handle 5 or the pointer 10, as the case may be, kept, by the surgeon looking along the leg, in line with the reference point in the lower limb, the femoral rasp (in practice a set of femoral rasps one after another) is used to form the cavity 2 to receive the femoral prosthesis cementlessly. It will be appreciated that the angle set for the pointer 10 at the scale 8 will be the angle of version of the inserted femoral prosthesis.

With the final femoral rasp 14 in the desired position of the femoral prosthesis in the femur 3, the rasp handle is removed and is replaced by a trial head device 15 shown in Figures 3 and 7. The device 15 includes a semicircular metal head 16 the plane B of the base of which is at the desired orientation to the femur. The head 16 is fixed to a metal neck 17 itself fixed to a metal plate 18 lying face-to-face on the proximal end of the rasp 14. A screw 19 extending through a hole in the plate 18 is screwed into the threaded bore in the proximal end of the rasp 14 to fix the plate 18 to the rasp 14. For extra security, the plate 18 is formed with a pin 20 which fits in a slot in the proximal end of the rasp 14. To enable the screw 19 to be tightened and loosened, the head 16 is formed with a bore 21 therethrough for receiving a screwdriver.

Having now predetermined the position of the head of the femoral prosthesis, the surgeon now places into the acetabular jig device 22 a plastics trial cup 23, and places these two items in the acetabulum 24, as shown in Figure 7. The jig device 22 is illustrated in Figure 4 and consists of a metal bush 25 formed around

its proximal rim with two fixed metal spikes 26 spaced 120° apart. Spaced 120° apart from each of the fixed spikes 26 is a movable metal spike 27 at the proximal end of a lever 28 pivoted at 29 in a slot 30 in an arm 31 protruding radially outwardly from the bush 25. The pivot 29 is at about the level of the distal rim of the bush 25. The arm 31 is formed with an internally threaded bore 32 perpendicular to the axis of the bush 25. A screw 33 in the bore 32 can be screwed inwards to turn the lever 28 about the pivot 29 to urge outwards the spike 27. Fixed to the arm 31 is another arm 34 formed at its outer end with an internal square hole and an external thread for receiving the handle 35 shown in Figure 5.

The handle 35 includes a cranked rod 36 formed at its outer end with a knurled grip 37 and at its inner end with a square-section peripheral surface 38 for engaging in the square hole in the arm 34 to give a selection of orientations of the rod 36 relative to the bush 25. The rod 36 is shown encircled by a sleeve 39 which is knurled at 40 at its outer end and is formed at its inner end with an internal thread 41 for engaging the external thread on the arm 34 to hold the rod 36 in its selected orientation. For this purpose, the rod 36 is formed with a collar 42 within the sleeve 39 and the sleeve is counterbored to form a shoulder 43 to prevent the rod 36 from being withdrawn from the internal square hole in the arm 34.

The trial cup 23 shown in Figure 6 is a sliding fit in the bush 25, but is provided at its distal end with an outwardly protruding flange 44 which comes to bear upon the distal rim of the bush 25.

With the trial head 16 inserted into the trial cup 23, the surgeon manoeuvers the device 22 (and thus with it the trial cup 23), using the handle 35, until the plane C of the distal rim of the trial cup 23 is

parallel to the plane B. When this has been achieved, the surgeon screws inwards the screw 33 to press the spikes 26 and 27 firmly into the bone of the acetabulum 24. The trial head 16 is removed from the trial cup 23 and the trial cup itself removed from the jig device 22.

The surgeon now inserts into the bush 25 an eccentric bush 46 which is shown in Figures 8 and 9 and which again is a sliding fit in the bush 25 and is formed with a distal end flange 47, but has a cylindrical internal surface 48 which is eccentric relative to its own cylindrical external surface, although having its axis parallel to that of this external surface. This bush arrangement 25, 46 allows the surgeon to select the position of the prosthetic cup in the acetabulum, by his turning the bush 46 until, visually, the axis of the bush 46 coincides with his desired position of the axis of the prosthetic cup in the acetabulum.

Once the desired position of the bush 46 has been achieved, the surgeon introduces into the bush 46 the end cutting pilot reamer 50 shown in Figure 10. The reamer 50 includes a shaft 51 formed at one end zone as a bone drill 52. A short distance from that end are radial reamer blades 53. Each blade 53 includes a radial cutting edge 54 followed radially outwardly by a cutting edge 55 oblique to the axis of the reamer. These blades 53 are mounted in a head 56 fixed to the shaft 51. The external periphery of the head 56 is of a smooth cylindrical form and therefore non-cutting and is a sliding fit in the bush 46. The surgeon operates the reamer 50 until, as shown in Figure 11, the bone drill 52 has pierced a bore 57 completely through the acetabular floor and the blades 53 have cut a recess 58 shaped correspondingly to themselves into the acetabular floor around the bore 57.

The surgeon now removes the reamer 50, the eccentric bush 46 and the device 22 from the acetabulum and inserts therein the reamer 60 shown in Figure 12. The reamer 60 includes a shaft 61 which at one end zone 62 is plain and of a diameter to fit in the bore 57. A short distance from that end is a radial annular surface 63 of a reaming head 64 fixed to the shaft 61. The surface 63 is followed outwardly by an annular frusto-conical surface 65 which is of course oblique to the axis of the reamer 60, and this surface 65 is followed by peripheral cutting blades 66 which have cutting edges 67 which are less oblique to the axis of the reamer 60. The shapes and sizes of the surfaces 63 and 65 correspond to the shapes and sizes of the surfaces of revolution of the cutting edges 54 and 55, respectively. The surgeon operates the reamer 60 to ream out the acetabulum to a substantially frusto-conical shape corresponding to that of the acetabular cup 90 (see Figures 16 and 17) to be inserted in the acetabulum. The non-cutting surfaces 63 and 65 co-opeate increasingly with the corresponding surfaces of the recess 58 to align the reamer 60 with the axis of the bore 57 and also prevent over-reaming of the acetabulum.

The surgeon then removes the reamer 60 from the acetabulum and inserts instead the tubular guide 70 shown in Figure 13 and containing the guide pin 80 shown in Figure 14. The guide 70 has the external surface 71 of its wider end zone shaped to fit in the reamed recess in the acetabulum. Internally, the guide 70 is formed with a shouldered bore 72 dimensioned to receive, and guide movement of, the guide pin 80. The guide pin 80 includes a shank 81 formed with an hexagonal hole 82 in one end thereof for receiving an hexagonal screwdriver and fixed at its other end to a externally screwthreaded head 84, the diameter of the

base of the thread being equal to the diameter of the bore 57. The surgeon inserts a screwdriver into the hole 82 and screws the head 84 into the bore 57 to fix the pin 80 relative to the acetabulum. The guide 70 is then removed and, as illustrated in Figure 15, the thread tap 85 is brought up to the reamed acetabulum 24 containing the fixed shank 81. The tapping head 86 having multi-start threads 87 is formed co-axially with a guide bore (not seen) which is fitted over the shank 81. The tap handle 88 is then rotated to form multi-start threads in the peripheral wall of the acetabulum. Then the tap 85 and the pin 80 are removed and there is screwed into the acetabulum the cup 90 with its multi-start threads 91 corresponding to the threads 87.

Finally, the femoral rasp is removed and replaced by the stemmed femoral prosthesis, the head of which is fitted into the cup 90.

CLAIMS

1. Apparatus for use in accurately inserting an acetabular cup, comprising an acetabular jig device mountable at the acetabulum for guiding a cutting tool to form in the acetabulum a cut-away of a desired profile at desired orientation and position, said device including an acetabular locating member, and an femoral locating device mountable at the femur and including a femoral locating member femur and including a femoral locating member femur and including a femoral locating member for co-operating with said acetabular locating member to aid in locating and in locating said acetabulum.

2. Apparatus as claimed in claim 1, wherein said jig device also includes a bush provided with teeth for engaging in the bone of the acetabulum, said bash serving to receive said acetabular.

3. Apparatus as claimed in claim 2, wherein said teeth comprise a first tooth fixed to said bush and a second tooth displaceable towards and away from the axis of said bush, and wherein said acetabular jig device includes a manually operable driving member for driving said second tooth away from said axis and for releasably maintaining said second tooth in the driven-away position.

4. Apparatus as claimed in claim 3, wherein said second tooth is fixed to one arm of a lever pivotally supported by said bush and wherein said driving member is arranged to act drivingly on the other arm of said lever.

5. Apparatus as claimed in any one of claims 2 to 4, and further comprising an eccentric bush for guiding a reamer and having an external surface which can fit closely in the internal surface of the first-mentioned bush and having an internal surface which is eccentric

relative to the external surface of the eccentric bush, although having its axis substantially parallel to that of this external surface.

6. Apparatus as claimed in any one of claims 2 to 4, and further comprising a front cutting reamer which is formed at one end zone as a bone drill and which is provided at a short distance from that one end with front cutting edges and which has an outer peripheral surface whereby said acetabular jig device guides said reamer.

7. Apparatus as claimed in claim 6, and further comprising a side cutting reamer which is formed at one end zone with a non-cutting bearing surface and which is formed peripherally with side cutting edges.

8. Apparatus as claimed in claim 6 or 7, and further comprising a guide pin formed at one end with a thread for screwing into a bone drilled through an acetabular floor by said bone drill.

9. Apparatus as claimed in any preceding claim, wherein said acetabular locating member and said femoral locating member comprise a locating cup with a part-spherical internal surface and a locating head with a part-spherical external surface.

10. Apparatus as claimed in claim 2 or claim 9 as appended to claim 2, wherein said acetabular locating member has an external peripheral surface which fits closely in the internal surface of the bush included in said acetabular jig device.

11. Apparatus as claimed in any preceding claim, wherein said femoral locating device comprises an intramedullar cutting member upon which said femoral locating member is mounted.

12. Apparatus as claimed in claim 11, and further comprising a version indicating device mountable upon said intramedullar cutting member and including a

support, an angular scale centered upon an axis, and an indicator turnable about said axis.

13. Apparatus for use in accurately inserting an acetabular cup, substantially as hereinbefore described with reference to the accompanying drawings.

14. Apparatus for use in accurately inserting a stemmed prosthesis, comprising a version indicating device mountable upon a stemmed member for intramedullary introduction and including a support, an angular scale centered upon an axis, and an indicator turnable about said axis.

15. Apparatus as claimed in claim 14, and further comprising a handle attachable to said stemmed member so as to extend transversely of said stemmed member, said support being mountable on said handle so as to be turnable about the axis of said handle.

16. Apparatus as claimed in claim 15, wherein said support is turnable through 360° about the axis of said handle.

17. Apparatus for use in accurately inserting a stemmed prosthesis substantially as hereinbefore described with reference to Figure 2 of the accompanying drawings.